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After referring to his letters to Padre Secchi published in the Bulletins of the Observatory of Rome, he reproduces the results as to the August meteor, see *Monthly Notices*, pp. 133–134. He remarks: "In the writings referred to, the position of the Radiant Point of the November Meteors had been taken as the point determined by the American observations of 1833, viz. γ *Leonis*, which is erroneous by several degrees. The new calculation, compared with Dr. Oppolzer's elements of the comet *Ast. Nach.* 1624, the perihelion passage being reduced to Milan Mean Time, is—

	Meteors. 13th Nov.	Comet I, 1866.
Perihelion passage	Nov. 10. 092	Jan. 11, 160
Longitude of Perihelion ...	56° 25′ 9″	60° 28′ 0″
Node	231 28 2	231 26 1
Inclination	17 44 5	17 18 1
Perihelion distance ...	0·9873	0·9705
Excentricity	0·9046	0·9054
Semi-axis major ...	10·340	10·324
Revolution	33·250 years	33·176
Motion	retrograde	retrograde

where it is assumed, 1°, the time of max. of the meteors is Nov. 13 13^h 11^m Greenwich M.T.; 2°, the position of the radiant point, long. 143° 12′, lat. N. 10° 16′; 3°, period 33·25 years (Newton). The position of the radiant point is that determined by Mr. Herschel, *Monthly Notices*, vol. xxvii. p. 19; but taking the longitude 145° instead of 143° 12′, the discrepancy of 4° in the longitude of perihelion would be made to disappear." M. Schiaparelli asks, Are the meteors to be considered as swarms of minute comets, or as the products of the dissolution of large comets?

Orbit of 44 *Boötis* (H I. 15=Sh 193=Σ 1909).

By S. W. Burnham.

As a double star this was discovered by Herschel August 17, 1781, and the position-angle by a single measure recorded at that time as 29°·9 *nf*, which, according to the mode of reckoning then in use, would give 60°·1. The distance was estimated to be "one-half or three-fourths diameter of S [smaller star]." It does not appear to have been looked at again by Herschel until 1802·25, when, according to his MS. observations, he made the angle 27° *sp* (=243°). These observations are cited in the Catalogue of Herschel II. and South (*Phil. Trans.* 1824), and

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also a later note in the MS. of Herschel I., under date of 1803·19, in which it is stated, "the position is not *sp*, as marked in the last observation [1802·25], but *nf.* Distance, one-half diameter of S$''$. This correction would change the angle of that time from 243° to 63°, and thus apparently show little or no change in the twenty years preceding. From the description the distance would appear to be a little less than at the first observation. The angle was measured by Struve in 1819, and the distance estimated at 1$''$·5. The next published observation is found in the Catalogue of Herschel and South, who entered it as No. 193 of their list, and measured it on two nights in 1821. They remarked the non-agreement of their angle (229°·1) with the previous measures of Herschel I., and said, "The identity of this star with H I. 15 may be questioned, as it is not impossible that there may be another double star of the first class near the same place with which it has occasionally been confounded. If not, or unless one or both of the stars be variable in magnitude, it is not easy to reconcile the observations." They also compare their position with that of Struve in 1819, and conclude that there can be no rapid motion, as had been suggested by that observer. Struve's observations were resumed in 1826, and show a steady increase in the distance from that time to 1837, with a slight advance in the angle.

Herschel in 1831 (*Mem. R.A.S.*, vol. xlvi.), after giving the measures down to 1830, says :—

"The history of the star 44 *Boötis* is singularly beset with difficulties and apparent contradictions. It is true that an orbit passing nearly through the eye, and so situated that the longer axis of the ellipse into which it is projected shall form an angle of about 6° with the meridian, would account for the remarkable jump the small star seems to have made from one side to the other of the large one ; for its very slow motion between 1781 and 1802 (especially if we admit some conspiring errors in those angles), and for its moderate velocity at present, but a year or two more of observations will probably suffice to render present conjecture needless."

It is probable that the angle of 6° mentioned in this extract is a misprint for 60°, which corresponds to the general apparent movement of the companion. A writer in *Nature* (vol. xiii. 69), in a note on Doberck's orbit, then recently published, suggests that the angle of Herschel in 1802 should not be 63°, as now taken upon the authority of Herschel's MS. correction (making the observation 27° *nf*, instead of 27° *sp* as at first given), but 207° (180° + 27°), and points out that with this correction it agrees perfectly with the position of the star in 1802, according to Doberck's orbit. He says :—

"It is now pretty evident from a projection of all the measures to 1875 that the quadrant was correctly registered *sp*, and consequently the quadrant for 1802·24 should be 207°, according to our present mode of reckoning. The angle calculated for this

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time from the above orbit is 206° 55′, and this close agreement must be taken as very satisfactory evidence that Dr. Doberck has given us something like the true orbit, notwithstanding the difficulty of the case."

In a subsequent reference to this matter (*Observatory* II. 210), Doberck refers to the suggested correction and its agreement with his orbit, and explains why he rejected in his computation Herschel's position of 63° for 1802, and relied only upon that for 1781.

But these astronomers have overlooked the important fact that under no circumstances could the suggested position-angle be correct. At this time all readings of the micrometer were invariably reckoned from the parallel, that is, added to or subtracted from 270° or 90°, as the case might be. If Herschel inadvertently recorded the angle of the larger instead of the smaller star, or in other words made an error of 180°, and entered it as 27° *sp* instead of *nf*, the true angle would be 243° (270°—27°) instead of 63° (90°—27°), but it could not possibly be 207° (180°+27°) any more than it could be 360°—27°. Such a method of reckoning was never used by Herschel or any one else.

It is possible that Herschel's angles of 1781 and 1802, placing the smaller star in the first quadrant, and in nearly the same direction from the principal star, are substantially correct. There may have been a decided change in the distance during that interval, by a separation and a subsequent approach of the stars, which would not have shown at the time of his observations, even if the distance had been measured. At this time we know absolutely nothing of the form of the apparent orbit, and until this is made to appear with reasonable certainty from the measures which commence with Struve, we cannot safely make any use of the observations prior to that time.

Flammarion in 1878 (*Catalogue des Étoiles Doubles et Multiples*) mentioned the nearly rectilinear motion of the companion, and came to the conclusion that the maximum distance had been reached, and that the companion would then commence to retrace its path towards the primary. He thought that an occultation must have taken place at the beginning of this century, and that this phenomenon would recur on the other side of the orbit about the year 1945; and that if the oscillation of the companion with respect to A was symmetrical, the period should be about 280 years.

Two orbits have been computed of this system :

1852	Mädler	181 years	Dorp. Obsns. xiii.
1875	Doberck	261·12 ,,	A.N. 2064.

The years given above indicate the dates of the last measures used by the respective computers.

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It is certainly evident now that there was nothing at these times upon which to base a determination of the periodic time, or the form of the apparent orbit, even if the position of Herschel in 1781 was correct. While the position in the first quadrant might limit the ellipse on the following side, the subsequent measures could not in any manner indicate the extent of the ellipse in the opposite direction, and the period might be anything the computer saw fit to make it. It is hardly necessary to add that the same uncertainty exists at the present time, and so far as one can judge from all the measures, it will be a long time, possibly another hundred years, before a sufficient arc will be passed over to warrant any attempt to investigate the elements of the orbit. The total angular motion during the time covered by the reliable measures is not more than 13°, and the apparent change is nearly rectilinear. There is certainly no doubt that these stars constitute a physical system, and are likely to be hereafter of more than ordinary interest. The components have a considerable common proper motion. The latest determination by Porter gives an annual movement of 0″·401 in the direction of 276°·0.

In fig. 1 I have given the early measures by the leading and best observers, laid down to scale in the usual way. These fifteen positions are made up as follows :—

1819	Σ		1848	OΣ and Da	6*n*
1821	Sh	2*n*	1852	Ma	30*n*
1826–1837	Σ (6)	20*n*	1854	Δ	13*n*
1840	OΣ and Da	14*n*	1856	OΣ and Δ	9*n*
1842	OΣ and Da	10*n*	1859	Ma and Δ	10*n*

The last position on the diagram shown by the larger circle is from the mean result of 26 sets of measures from 1863 to 1895. These measures include altogether observations on 108 nights by the following observers :—

O. Struve	12*n*	Hall	32*n*
Dembowski	18*n*	Comstock	5*n*
Schiaparelli	37*n*	Maw	2*n*
	Collins	2*n*	

In fig. 2 all the individual sets of measures above referred to are laid down on square-ruled paper in order to show more clearly the changes in angle and distance at the corresponding dates shown on the lower line of the diagram. It is apparent from inspection that there has been no sensible change in the distance since 1860. There may have been a slight increase in the angle for a short time after this date, but it is by no means certain. We may assume that for the last thirty years these stars have remained relatively fixed so far as the measures are concerned.

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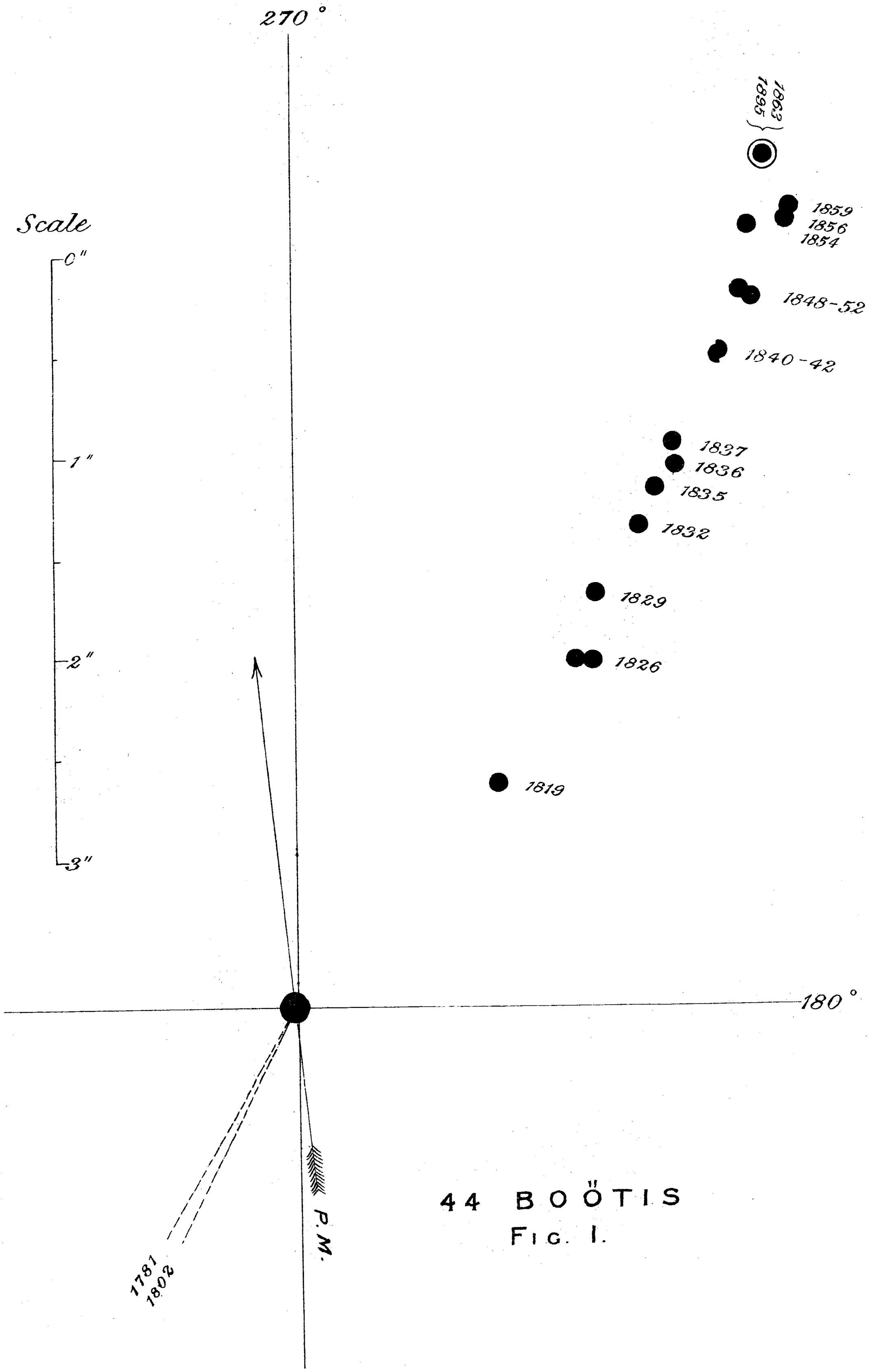

44 BOÖTIS
FIG. 1.

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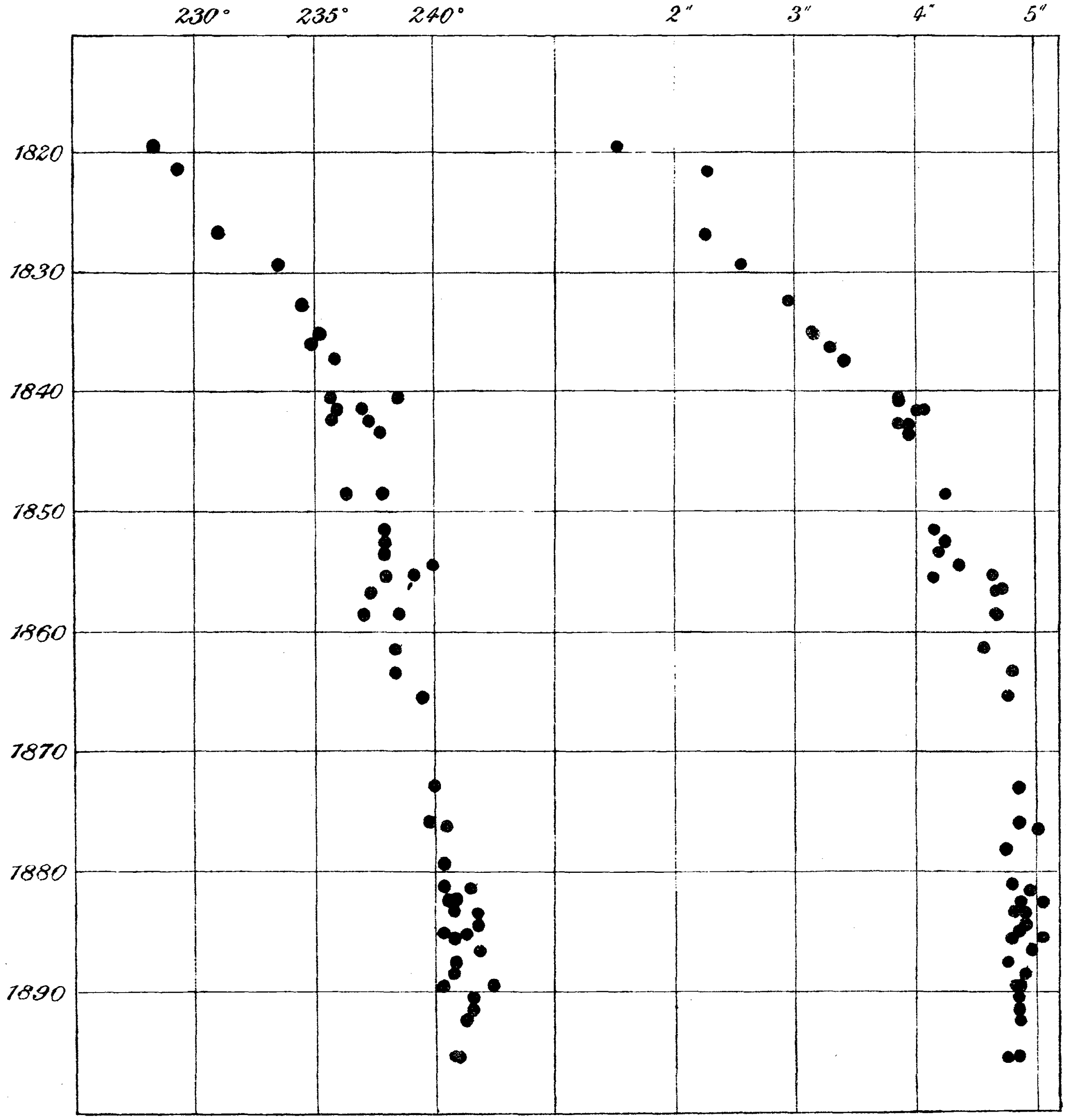
FIG. 2.



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In the following table I have given the variations of the several sets of measures made between 1863 and 1895 from the two means, one of all the measures between these years, and the other of the measures from 1881 to 1895. It will be seen that these variations are practically insensible, and less or no larger than the probable error of any observer when his results are compared one with another.

	1863—1895.		1881—1895.		
	°	″	°	″	
1863·44	−2·5	−0·04	...	...	OΣ
1865·36	−1·3	−0·08	...	...	Δ
1873·00	−0·7	+0·03	...	...	Δ
1876·10	−1·1	+0·02	...	...	Sp.
1876·47	−0·3	+0·19	...	...	Hl.
1879·18	−0·4	−0·08	...	...	Sp.
1881·11	−0·4	−0·04	−0·7	−0·07	Sp.
1881·40	+0·5	+0·10	+0·4	+0·07	Hl.
1882·41	+0·2	+0·21	−0·1	+0·18	Hl.
1882·50	−0·2	+0·04	−0·5	+0·01	Sp.
1883·47	+0·9	+0·08	+0·6	+0·05	Hl.
1883·47	+0·2	−0·01	−0·5	−0·04	Sp.
1884·44	+0·8	+0·09	+0·5	+0·06	Hl.
1884·97	−0·5	+0·04	−0·8	+0·01	OΣ
1885·38	+0·4	+0·20	+0·1	+0·17	Hl.
1885·46	−0·1	−0·03	−0·4	−0·07	Sp.
1886·43	+1·1	+0·12	+0·8	+0·09	Hl.
1887·57	+0·2	−0·08	−0·1	−0·11	Sp.
1888·42	+0·1	+0·07	−0·2	+0·04	Hl.
1889·51	+1·7	−0·04	+1·3	−0·07	Hl.
1889·61	−0·5	+0·01	−0·8	−0·02	Maw
1890·48	+0·8	+0·01	+0·5	−0·02	Hl.
1891·45	+0·7	+0·03	+0·4	0·00	Hl.
1892.58	+0·5	+0·01	+0·2	−0·02	Com.
1895·43	+0·2	+0·03	−0·1	0·00	Col.
1895·49	+0·3	−0·11	0·0	−0·14	Com.

The special object of this paper is not to point out the unwarranted conclusions reached heretofore respecting this star as a binary system, but to call attention to the singular and remarkable arrest of the relative motion of the two stars. For more than thirty years these stars gradually increased their distance from 1″·5 to about 4″·8 at a nearly uniform rate, with a slow advance in the angle; and then all motion is arrested, and

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for a like period of about thirty years, and down to the present time they have remained absolutely at rest so far as one can tell from full and careful sets of measures by the best double star observers. So far as I know, there is no other instance of this kind known in the heavens. There is no lack of examples of double stars where the motion as shown by the various measures is apparently peculiar, and possibly inconsistent with the theory of the mutual attraction of the observed bodies; and various speculations have been advanced to explain the so-called irregular variable motions. A dark or invisible star is usually interposed to account for the observed movements. With all the latitude afforded by the unavoidable errors of observation, which very often appear to assume a systematic form, it is not difficult in any instance to suggest an undiscovered disturbing body which, according to the terms of the proposed hypothesis, shall appear to more or less perfectly account for the observations, but in most instances the disturbing body is more likely to be finally discovered at the smaller end of the telescope than elsewhere.

With respect to this star, I have only to add that it seems to furnish an example, perhaps the only one, of so peculiar motion that the explanation is not readily suggested by the observations themselves. The steady change in the position of the smaller star for about forty years, and the subsequent arrest of its motion, which has continued down to the present time, are both apparently established by unimpeachable observations by the best observers. Of course any attempted explanation at this time would be premature, at the best only speculation, and would have no value, and presumably no interest. The usual dark body will readily suggest itself, and it is easy to imagine one of these stars having an invisible companion, the two moving in a very eccentric orbit, the plane of which is nearly in the line of sight, and to select a period and direction of motion for the hypothetical pair such as will explain approximately not only the motion, but the absence of motion, shown by the observations of the invisible components; and when this is presented with the usual refinements of computation, doubtless for the time being a plausible case could be made out. When the relative motion has been resumed, and a decided change has taken place, there may be no difficulty in determinining with substantial accuracy the general form of the orbit, and explaining the apparent anomalous relative movement of these stars, without assuming the existence of any third member of the system.

On a New Binary of Short Period in the Constellation Dorado $=H_2$ 3683. By T. J. J. See, A.M., Ph.D. (Berlin).

While sweeping over some of the brighter stars in the constellation *Dorado*, January 14, I recognised the duplicity of a yellow star of the 6·5 magnitude; under a power of 520 the components were just well separated, and in brightness rated at